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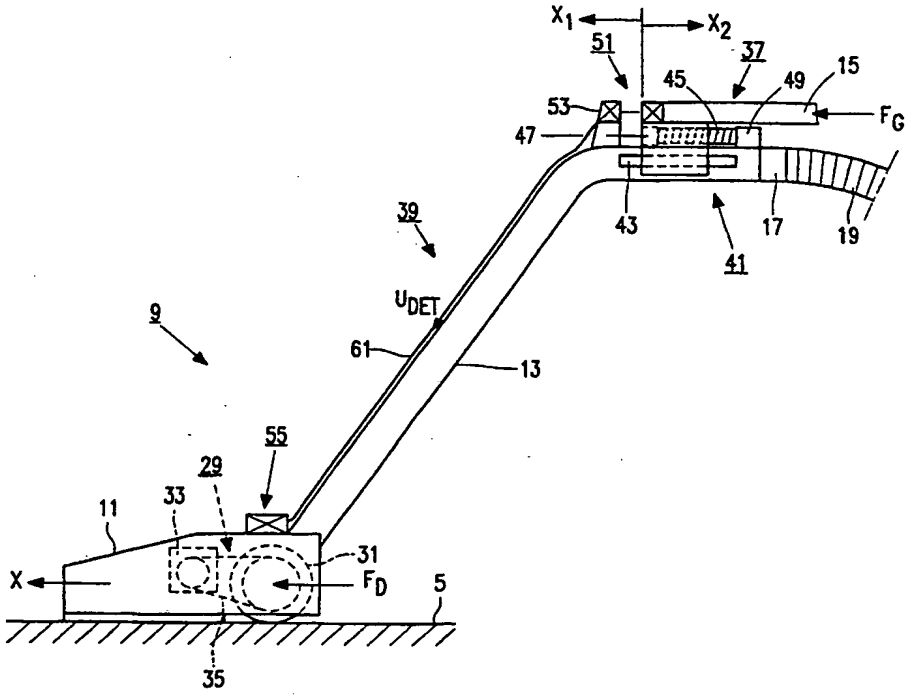
(54) Title: VACUUM CLEANER PROVIDED WITH A SUCTION NOZZLE WITH CONTROLLABLE ELECTRICAL DRIVE MEANS

(57) Abstract

A vacuum cleaner with a suction nozzle (11) which is coupled to a handle (15) on which a user of the vacuum cleaner can exert a pushing or pulling force (F_G) for moving the suction nozzle (11) over a surface (5) to be cleaned. The suction nozzle (11) is provided with electrical drive means (29) for exerting a driving force (F_D) on the suction nozzle (11), such that the pushing or pulling force (F_G) to be exerted by the user is limited. According to the invention, the vacuum cleaner comprises a detector (51, 81) capable of measuring the pushing or pulling force (F_G) exerted on the handle (15) and an electrical controller (57) for controlling the driving force (F_D) as a function of the measured pushing or pulling force (F_G). The controller (57) controls the driving force (F_D) in such a manner, for example, that the measured pushing or pulling force (F_G) remains substantially zero. It is thus possible for the user to move the suction nozzle (11) effortlessly over the surface (5) to be cleaned. In a special embodiment, the handle (15) is coupled to the suction nozzle (11) by means of an elastically deformable coupling member (41; 69), while the detector (51, 81) comprises a position sensor (53, 83) for measuring a position of the handle (15) with respect to the suction nozzle (11).



Vacuum cleaner provided with a suction nozzle with controllable electrical drive means

Description

The invention relates to a vacuum cleaner with a suction nozzle and a handle which is coupled to the suction nozzle during operation, said suction nozzle being provided with electrical drive means for exerting a driving force on the suction nozzle, while the vacuum cleaner comprises a detector by means of which at least a direction is controllable in which the drive means exert the driving force on the suction nozzle during operation.

In a known vacuum cleaner of the kind mentioned in the opening paragraph, the electrical drive means of the suction nozzle comprise an electric motor which is arranged in the suction nozzle for driving a set of drive wheels with which the suction nozzle rests on a surface to be cleaned during operation. The detector of the known vacuum cleaner comprises a switch having three positions which controls a direction of rotation of the motor and which is in contact with the surface to be cleaned during operation. If a user of the vacuum cleaner pushes the suction nozzle in a forward direction, the switch is forced into a first extreme position under the influence of the friction between the switch and the surface to be cleaned, in which position the motor drives the drive wheels with a substantially constant speed in a direction of rotation which corresponds to the forward direction. If the user pulls the suction nozzle in a backward direction, the switch is forced into a second extreme position under the influence of said friction, in which position the motor drives the drive wheels with a substantially constant speed in a direction of rotation corresponding to the backward direction. If the user keeps the suction nozzle in a fixed position on the surface, the switch is displaced to an intermediate position situated between said two extreme positions, in which the motor does not rotate. The electrical drive means thus exert a driving force on the suction nozzle via the drive wheels in a direction of movement of the suction nozzle desired by the user. A pushing or pulling force to be exerted on the handle by the user is considerably reduced thereby.

It is a disadvantage of the known vacuum cleaner that the drive wheels are driven with a substantially constant speed. As a result, the driving force delivered by the drive means will not lead to a speed of movement of the suction nozzle over the surface to be cleaned desired by the user in many cases. If the user wishes to reverse the direction of

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surface to be cleaned by the user, who will experience a certain contact force defined by said predetermined value during moving of the suction nozzle, which promotes the accuracy with which the suction nozzle is displaceable over the surface to be cleaned by the user.

A further embodiment of a vacuum cleaner according to the invention is characterized in that the controller controls the driving force such that the measured pushing or pulling force remains substantially zero during operation. Since the pushing or pulling force to be exerted on the handle by the user remains substantially zero, the user will indeed experience no contact force in this further embodiment of the vacuum cleaner according to the invention, but the suction nozzle can be displaced over the surface to be cleaned without any effort.

A yet further embodiment of a vacuum cleaner according to the invention is characterized in that the vacuum cleaner is provided with a first part which is coupled to the handle in a fixed position as seen parallel to a direction of movement of the suction nozzle, and with a second part which is coupled to the suction nozzle in a fixed position as seen parallel to the direction of movement, the first part being coupled to the second part by means of an elastically deformable coupling member and being displaceable relative to the second part at least parallel to the direction of movement, as a result of which the coupling member is deformed, while the detector comprises a position sensor for measuring a position of the first part with respect to the second part. If the first part is displaced relative to the second part in that the user exerts a pushing or pulling force on the handle, said coupling member will be deformed such that the coupling member exerts an elastic deformation force on the first part having a value corresponding to the value of the pushing or pulling force exerted by the user. Since the value of said deformation force is determined by the value of the displacement of the first part relative to the second part, the deformation force can be determined from the position of the first part relative to the second part measured by the position sensor. The pushing or pulling force exerted on the handle by the user can thus be measured in a simple manner through the use of said position sensor.

A special embodiment of a vacuum cleaner according to the invention is characterized in that the controller controls the driving force such that the first part is in a substantially constant position relative to the second part during operation, in which position the coupling member is substantially undeformed. If the user exerts a pushing or pulling force on the handle of this special embodiment of the vacuum cleaner according to the invention, such that the first part is displaced relative to the second part, the drive means will exert a driving force on the suction nozzle substantially immediately to the effect that the

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Fig. 4 diagrammatically shows a second embodiment of a suction attachment of the vacuum cleaner of Fig. 1.

The vacuum cleaner according to the invention shown in Fig. 1 is a so-called floor-type (horizontal) vacuum cleaner comprising a housing 1 which is displaceable over a surface 5 to be cleaned by means of a number of wheels 3. An electrical suction unit 7, shown diagrammatically only in Fig. 1, is accommodated in the housing 1. The vacuum cleaner further comprises a suction attachment 9 which comprises a suction nozzle 11, a hollow tube 13, and a handle 15. The handle 15 is detachably coupled to a flexible hose 19 by means of a first coupling 17, while the flexible hose 19 is detachably coupled to a suction opening 23 provided in the housing 1 by means of a second coupling 21. The suction opening 23 issues into a dust chamber 25 of the housing 1 which is connected via a filter 27 to the suction unit 7. During operation, the suction unit 7 generates an underpressure in a suction channel which comprises the suction nozzle 11, the hollow tube 13, the flexible hose 19, the suction opening 23, and the dust chamber 25 of the vacuum cleaner. Dust and dirt particles present on the surface 5 to be cleaned are removed through the suction attachment 9 and the flexible hose 19 to the dust chamber 25 under the influence of said underpressure, for which purpose a user of the vacuum cleaner moves the suction nozzle 11 parallel to a direction of movement X over the surface 5 to be cleaned in that he or she exerts a pushing or pulling force F_G on the handle 15 which is directed substantially parallel to the direction of movement X.

As Fig. 2 diagrammatically shows, the suction nozzle 11 of the suction attachment 9 comprises drive means 29 which comprise a pair of drive wheels 31 positioned next to one another, an electric motor 33 arranged in the suction nozzle 11 for driving the drive wheels 31, and a transmission 35 which is indicated diagrammatically only in Fig. 2. During operation, the drive wheels 31 are in contact with the surface 5 to be cleaned for exerting a driving force F_D directed substantially parallel to the direction of movement X on the suction nozzle 11. Since the suction nozzle 11 is driven by the drive means 29 parallel to the direction of movement X during operation, the pushing or pulling force F_G to be exerted on the handle 15 by the user is considerably reduced, whereby the ease of use of the vacuum cleaner is enhanced.

The value and the direction of the driving force F_D of the drive means 29 are controlled in a manner to be described further below. As Fig. 2 diagrammatically shows, the suction attachment 9 in a first embodiment comprises a first part 37 comprising the handle 15, and a second part 39 comprising the suction nozzle 11 and the hollow tube 13.

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input signal for an electrical controller 57 of the control system 55. The controller 57 is, for example, a PID controller which is usual and known per se and supplies an output signal u_{REG} to an electrical amplifier 59 which is usual and known per se and which supplies the electric motor 33 of the drive means 29 with an electric current i_M which is determined by the signal u_{REG} and which determines the driving force F_D delivered by the drive means 29. The driving force F_D is thus controlled by the controller 57 in a predetermined manner as a function of the measured pushing or pulling force F_G. As Fig. 2 diagrammatically shows, the control system 55 is mainly accommodated in the suction nozzle 11, the output signal u_{DET} of the detector 51 being conducted through an electrical conductor 61 running alongside the tube 13 to the controller 57 mounted in the suction nozzle 11.

The controller 57 determines the signal u_{REG} such that the output signal u_{DET} of the detector 51 has a substantially constant reference value which corresponds to a reference position x_0 of the first part 37 relative to the second part 39, as shown diagrammatically in Fig. 3, wherein the helical spring 45 of the coupling member 41 is substantially undeformed. It is achieved in this manner that the second part 39 with the suction nozzle 11 follows the first part 37 with the handle 15 as much as possible during operation, i.e. that the suction nozzle 11 is displaced as a result of the driving force F_D such that the handle 15 relative to the suction nozzle 11 remains in a substantially constant position in which the helical spring 45 is unloaded. Since it is thus substantially impossible for the user to deform the helical spring 45 under normal operational conditions, the user will experience substantially no reaction forces arising from the handle 15, and the pushing or pulling force exerted by the user on the handle 15 remains substantially zero during operation. In this manner the suction nozzle 11 can be effortlessly displaced by the user over the surface 5 to be cleaned under normal operational conditions.

The first part 37 with the handle 15 is displaceable from the reference position x_0, in which the helical spring 45 is substantially undeformed, in two mutually opposed directions parallel to the direction of movement X relative to the second part 39, i.e. in a forward direction X_1 shown in Figs. 2 and 3 and in a backward direction X_2, the helical spring 45 being deformable in both directions mentioned. It is thus possible by means of the detector 51 to measure both a pushing force in the forward direction and a pulling force in the backward direction. If the detector 51 detects a pushing force, in the forward direction, the controller 57 will control the motor 33 such that the drive means 29 supply a driving force in the forward direction. If the detector 51 detects a pulling force, in the backward direction, the controller 57 will control the motor 33 such that the drive means 29 supply a

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13, and a second part 67 which comprises the suction nozzle 11. The hollow tube 13 of the first part 65 is coupled to the suction nozzle 11 of the second part 67 by means of an elastically deformable coupling member 69 which is provided with two blade springs 71 and 73 which extend substantially perpendicularly to the direction of movement X. The blade springs 71 and 73 are fastened adjacent a first end to a fastening block 75 which is fastened to the hollow tube 13, and adjacent a second end to a fastening block 77 which is fastened to the suction nozzle 11. The hollow tube 13 is coupled to the suction nozzle 11 by means of a further flexible hose 79 which forms part of the suction channel of the vacuum cleaner. The use of said blade spring 71, 73 and said flexible hose 79 renders the first part 65 displaceable with respect to the second part 67 substantially parallel to the direction of movement X under elastic deformation of the two blade springs 71, 73. The suction attachment 63 further comprises a detector 81 by means of which a direction and a value of a pushing or pulling force F_G exerted by the user on the handle 15 during operation can be measured. The detector 81 for this purpose comprises, as does the detector 51, a position sensor 83, which is usual and known per se, for measuring a position of the first part 65 with respect to the second part 67. When the user exerts a pushing or pulling force on the handle 15, the first part 65 is displaced relative to the second part 67, so that the blade springs 71 and 73 are bent parallel to the direction of movement X. As a result of this, the coupling member 69 exerts an elastic deformation force on the first part 65 with a value and a direction which are determined by the value and the direction of the pushing or pulling force exerted by the user. Since the value and the direction of said deformation force are determined by the position of the first part 65 relative to the second part 67, the deformation force can be determined from the position of the first part 65 relative to the second part 67 as measured by means of the position sensor 83. The pushing or pulling force can thus be determined in a simple and practical manner by means of the position sensor 83, as was the case with the suction attachment 9 discussed earlier. Since the coupling member 69 is at a comparatively large distance away from the handle 15, however, a static deformation of the blade springs 71, 73 occurring under the influence of the force of gravity acting on the hollow tube 13 and the handle 15 should be taken into account in determining the pushing or pulling force. Such a static deformation can be compensated for by mechanical or electronic means in a manner which is usual and known per se and which will not be explained in any detail here. The detector 81 forms part of a control system 85 of the suction attachment 63 by means of which a value and a direction of the driving force F_D of the drive means 29 are controllable during operation in a manner corresponding to the manner in which the control system 55

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suction nozzle 11 and the hollow tube 13, whereas in the second embodiment of the suction attachment 63 the first part 65 comprises the handle 15 and the hollow tube 13, and the second part 67 comprises the suction nozzle 11. It is noted that the elastically deformable coupling between the first part and the second part according to the invention may be provided in an alternative location. The invention accordingly covers any alternative embodiment in which the handle 15 is coupled to the first part in a fixed position as seen parallel to the direction of movement of the suction nozzle 11, and the suction nozzle 11 is coupled to the second part in a fixed position as seen parallel to the direction of movement. Instead of the coupling members 41 and 69 discussed above, an alternative elastically deformable coupling member may then be used between the first part and the second part.

member is substantially undeformed in two mutually opposed directions which are parallel to the direction of movement.

7. A vacuum cleaner as claimed in claim 4, 5 or 6, characterized in that the first part comprises the handle, while the second part comprises the suction nozzle and a tube positioned between the handle and the suction nozzle.

8. A vacuum cleaner as claimed in claim 4, 5, or 6, characterized in that the first part comprises the handle and a tube arranged between the handle and the suction nozzle, while the second part comprises the suction nozzle.

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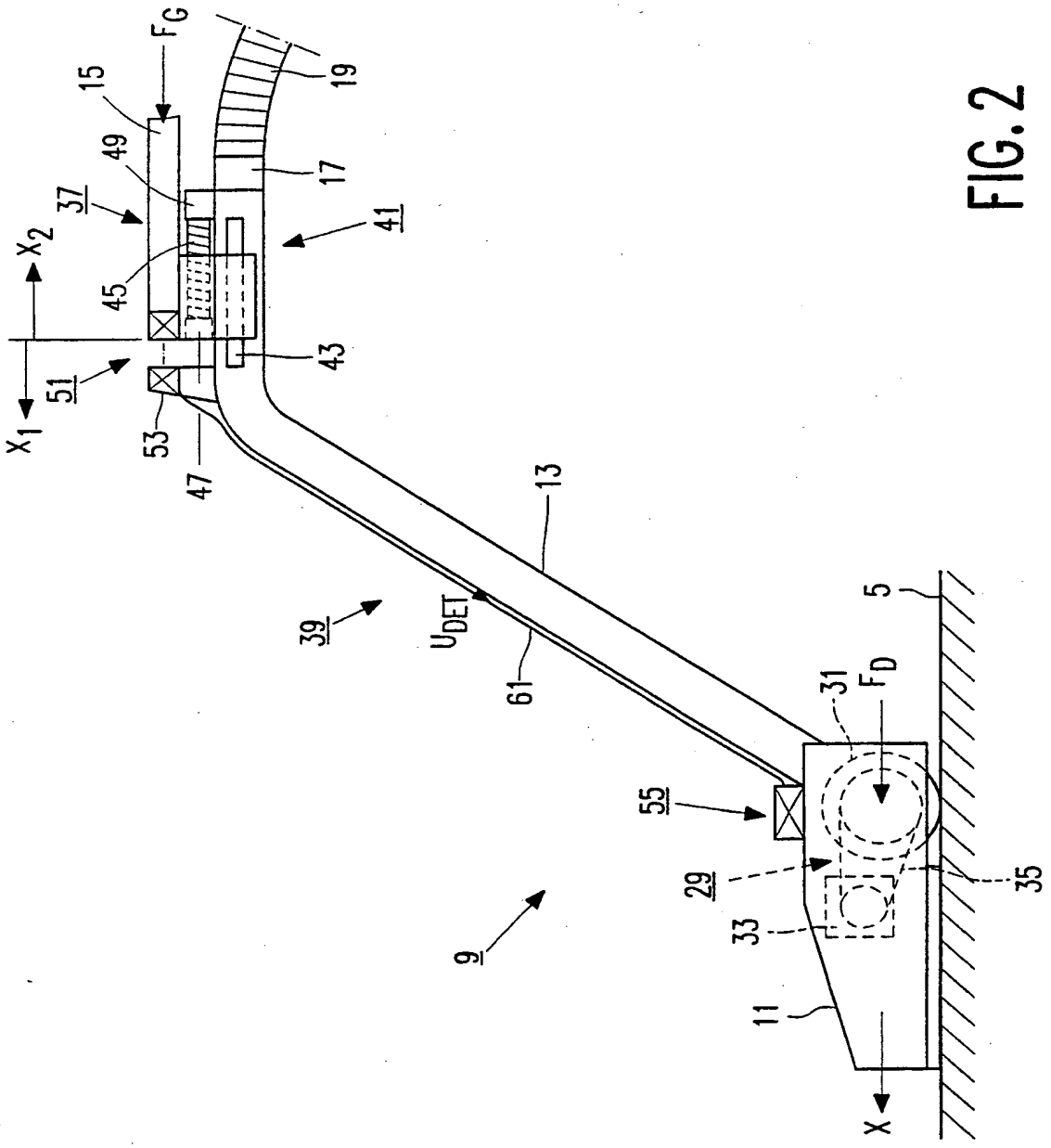

FIG. 2

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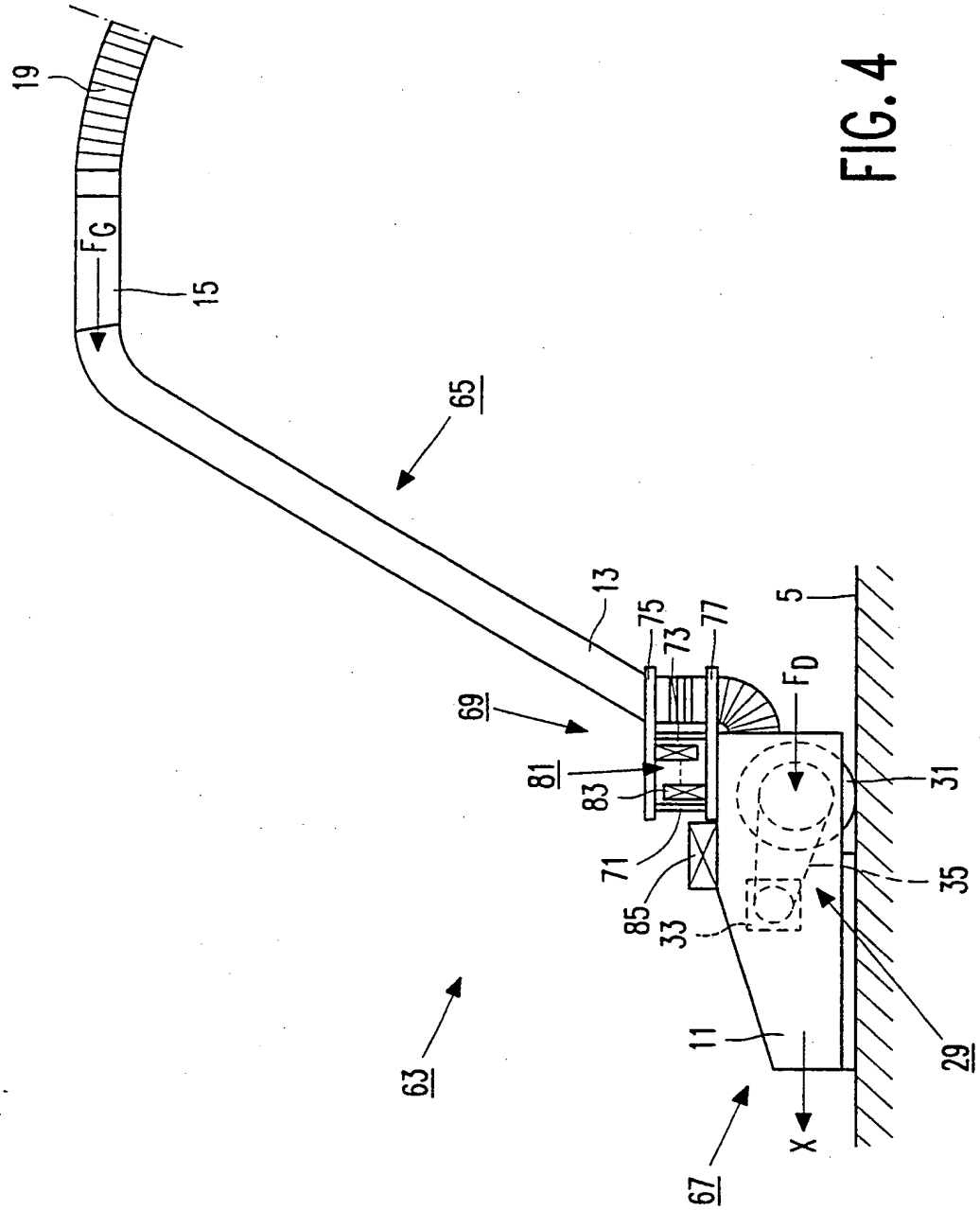

FIG. 4

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Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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